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ABSTRACT

Facts and activities related to weather and meteorology are presented in this unit. Separate sections cover the following topics: (1) the water cycle; (2) clouds; (3) the Beaufort Scale for rating the speed and force of wind; (4) the barometer; (5) weather prediction; (6) fall weather in Iowa (sleet, frost, and fog); (7) winter weather in Iowa (snow, snowflakes, blizzards, and treatment for cold weather exposure); (8) dew, hail, and rain; (9) thunderstorms and lightning; and (10) tornadoes. The types of materials provided in the unit include: pretests-posttests; explanations of weather forecasting, weather reporting, and different types of weather; illustrations; reading comprehension questions; experiments; charts; flannelboard and bulletin board ideas; science activities; art activities; word-find puzzles; supplemental activities; a list of locally available resources; and games. This document is part of a collection of materials from the Iowa Area Education Agency 7 Teacher Center project. (DC)

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WEATHER IN YOUR LIFE

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Pre-test and Post-test for the Water Cycle

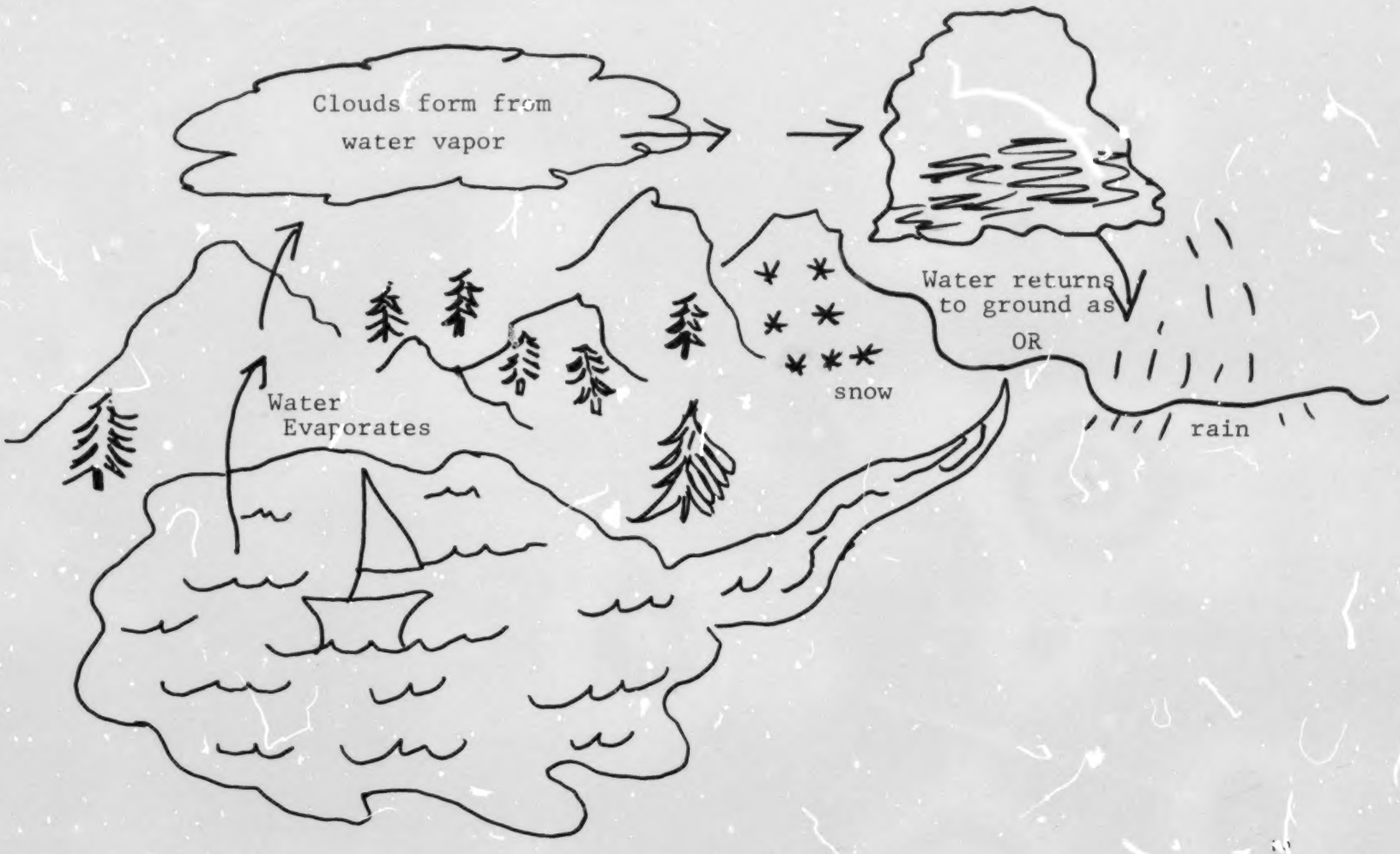
1. Fog is
   a. water b. cloud c. water vapor

2. Water that has turned into a gas-this change is called:
   a. condensation b. evaporation c. vaporization

3. When a gas turns into a liquid it is called:
   a. condensation b. evaporation c. vaporization

4. What are clouds made of:
   a. water vapor b. water droplets c. fog

WATER CYCLE


Clouds form from
water vapor
Water returns
to ground as
OR
snow
rain
Water
Evaporates

WATER CYCLE-Name given to all the changes from water to vapor and back to water

What does a cloud feel like? Did you know that fog is a low-flying cloud? Clouds are made of tiny droplets of water. But, how does water get into the sky?

As the sun heats water there are tiny particles in water that speed up and begin bumping into each other. As the particles bump each other some bounce right into the air and seem to disappear. The water has then turned to a gas which is called water vapor. We can't see this change as it happens. But we call this change evaporation.

Can you think of a couple of times you may have known evaporation was happening? How about a dish of water left outdoors? What happens to wet clothes hung out to dry?

Well, what happens to the water vapor? It moves about in the air. Warm air holds a lot of water vapor. As the warm air rises that has the water vapor, it cools. As the air cools some of the water vapor changes back to tiny droplets of water. When this happens, gas to liquid water, it is called condensation. Can we see condensation close to the ground? Yes, in the form of dew or frost. Dew and frost are formed when warm air strikes a cool object.

When many water droplets are in one place, we see clouds. And depending on the size of the droplets they may fall as rain or if it is cool enough as snow, hail, or sleet.

Check Yourself:

1. Suppose that on a cold day frost formed on the inside of your window. There must have been
   A. A lot of water vapor in the room
   B. Very little water vapor in the room
   C. A lot of water vapor outside

2. If you put one drop of water in a warm room and one drop in a cool room, the drop of water in the warm room would evaporate
   A. Faster than the water in the cool room
   B. At the same rate as the water in the cool room
   C. Slower than the water in the cool room

Teacher enter

3. When snow falls to earth, it would be correct to say that

   A. There is rain above the clouds

   B. There is wind below the clouds

   C. Water vapor has changed to ice crystals

4. Clouds will not form in the sky if

   A. Too many bits of dust are floating in the air

   B. All the water vapor in the air turns to ice

   C. There is no water vapor in the air.

EXPERIMENT

What happens when warm, moist air is cooled?

Directions:

1. Fill a drinking glass about half full of warm or hot water.
2. Place a second glass of the same size upside down over the first glass.
3. Put an ice cube on top of the second glass.
4. Notice what happens inside the top of the glass.

Using what you've read and done, think about this problem. Then write your answer and explain it.

In hot weather, cold-water pipes sometimes "sweat" or form beads of water because

A. Water leaks through the pipes

B. Droplets form high in the air and fall on the pipes

C. Water vapor in the air around the pipes condenses on the cool pipes.

What do you think?

1. What would our weather be like if the water cycle stopped right now-that is, if water did not change to water vapor and back to water?
2. Do you ever think man will learn enough to be able to control the water cycle, and have precipitation or dryness whenever he wants it?

Pre-test and Post-test for Clouds

1. Are all clouds at the same height above ground?
   a. yes b. no
2. How many main types of clouds are there?
   a. one b. three c. five d. six
3. Cumulus clouds can be seen on _____ days.
   a. foggy b. sunny c. overcast
4. Cumulus clouds mean bad weather
   a. yes b. no
5. Cumulonimbus clouds are
   a. wispy b. high and dark base c. overcast
6. These clouds form a ceiling over the earth.
   a. cirrus b. cumulus c. stratus d. cumulonimbus
7. The highest clouds are the
   a. cirrus b. cumulus c. stratus d. cumulonimbus
8. Cirrus clouds are made of
   a. water droplets b. ice crystals c. water vapor

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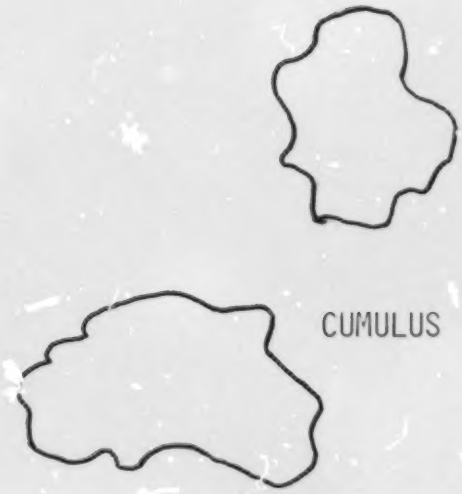
CLOUDS

There are three main types of clouds. They are different shapes, are at different heights above ground, and bring different types of weather.

Cumulus clouds look like bundles of white wool. These clouds are usually seen sailing across the sky on sunny days. The base of these clouds is quite flat and close to the earth. Cumulus clouds do not bring bad weather-unless-they begin to grow in heights and the base becomes very dark. If this happens you can expect a thunderstorm. These clouds are then called Cumulonimbus. They can bring heavy showers and often hail in warm weather. The rain from these clouds only falls in the areas directly under the clouds.

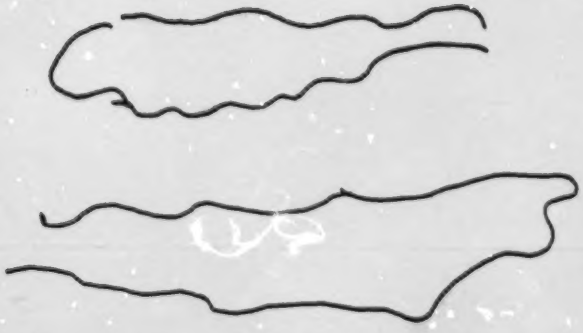
Stratus clouds form a ceiling over the earth. They are usually low to medium heights and may cover most of the sky. If these clouds become dark and thicken we can expect a slow and steady rain. Or if the temperature is cool enough there could be snow.

The highest type of clouds are the Cirrus. Since they are so high the temperature is very cool so these clouds are made of mainly small crystals of ice. Sometimes you can see them on cool, sunny days. The Cirrus clouds can sometimes bring snow.



CUMULUS

CUMULONIMBUS



STRATUS

CIRRUS

THE BEAUFORT SCALE

Scale Number	Name of wind	MPH	What the wind does
0	Calm	<1	Smoke goes straight up
1	Light Air	1-3	Smoke slightly bent
2	Light Breeze	4-7	Leaves rustle-wind vane moves
3	Gentle Breeze	8-12	Leaves and twigs in constant motion
4	Moderate Breeze	13-18	Raises dust and paper, moves small branches
5	Fresh Breeze	19-24	Small trees sway
6	Strong Breeze	25-31	Large branches in motion
7	Moderate Gale	32-38	Whole trees sway-walking is difficult
8	Fresh Gale	39-46	Breaks twigs off trees
9	Strong Gale	47-54	Damages chimneys and roofs
10	Whole Gale	55-63	Trees uprooted (Rare inland)
11	Storm	64-75	Widespread damage (Very rare inland)
12	Hurriance	Above 75	Most destructive of all winds

Wind is caused by air pushing from an area of high pressure to one of low pressure. The speed of the wind is determined by the difference in pressure-the greater the difference the faster the wind. Weatermen rate the force and speed of wind by the Beaufort Scale.

BAROMETER

A rising barometer indicates the approach of a high-pressure area, or "high" which usually contains cool, dry air. A falling barometer means that a low pressure area, or "low" is approaching. The air in a low is warm and holds more moisture than in a high.

The air pressure in a high is greater than that in a low because cool, dry air is heavier than an equal volume of warm moist air.

Highs are usually associated with clear, sunny weather because cool, dry air can absorb large quantities of moisture as the air becomes warmer.

Teacher enter

Pre-test and Post-test for Predicting Weather

1. How fast does weather move?
   a. 40 m.p.h. b. 30 m.p.h. c. 50 m.p.h. d. 20 m.p.h.

2. What is this a symbol for
   a. cold front b. warm air mass c. warm front d. low

3. What are air masses?

   _____

4. What happens when a warm air mass approaches a cold air mass?
   a. cold front b. low c. high d. warm front

5. What type of weather is likely in a high pressure area?
   a. rainy b. partly cloudy c. clear d. snow

6. What type of front is formed when two cold air masses meet?
   a. warm b. cold c. occluded d. stationary

PREDICTING THE WEATHER

Did you know that weather moves at a speed of about 30 miles an hour? How far would it move in a 24 hour period? That's right-720 miles! Since weather is constantly changing is the reason why a weather map is used. This way we have a broad picture of what is happening.

Air masses are the chief factors in weather. An air mass is a very large body of air-1,000 miles or more across-that has nearly the same temperature and moisture all through the large body. An air mass of one type or another is formed by being in one place for several days. If it stayed over a warm ocean, the air mass will be warm and moist. If it was over cold land, it will be cold and dry. A warm air mass usually comes from the southeast, south, and southwest. The cold air masses come from the north, cold regions around Canada.

The secondary factors in weather are the High and Lows. A high pressure region is an area where there is generally clear weather. In a High the air is settling gently downward and blows out from the center turning in a clockwise direction. In a High pressure region it is generally cool or cold especially when the winds are from the north or northwest. In a low pressure region there is generally cloudy weather-rain or snow. In the Low the air is being pushed upward and is blowing into and around a center. If the wind blows in from the east side it is generally warm air; if it blows from the west side it is usually cooler air. Highs and Lows stay in one place for only a few hours.

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Now back to our air masses. What happens if a warm air mass approaches a cold air mass? Well, the warm air will push up and blow over the cold air. This front that is formed is called a warm front. Clouds form and rain or snow are probably going to fall until the front passes.

What happens when a cold air mass approaches the warm air mass? Since cold air is heavier it will push itself under the warm air. This is called a cold front. Clouds usually form and there may be rain or snow.

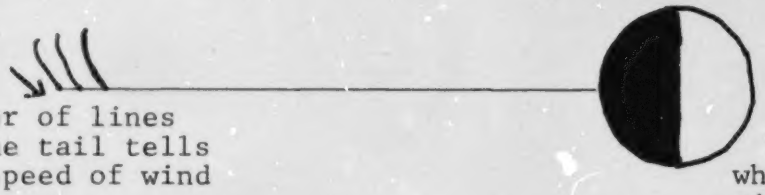
Sometimes after a front forms there may be very little motion for awhile and this would be called a stationary front.

Another type of front is an occluded front. This is formed when two cold air masses meet. One is usually colder than the other and will push itself underneath. When there is an occluded front it is usually an indication of bad weather.

What do you think?

What do you think weather forecasting will be like in the future?

Explanation of Arrows



Number of lines on the tail tells the speed of wind

The circle tells what the sky is like; cirlce is the head of arrow.

*arrow shows direction of wind

Symbol	Miles per hour
	calm
	1-3 (half feather)
	4-7 (whole feather)
	8-12
	13-18
	19-24
	25-31
	32-38
	47-54
	55-63
	above 75

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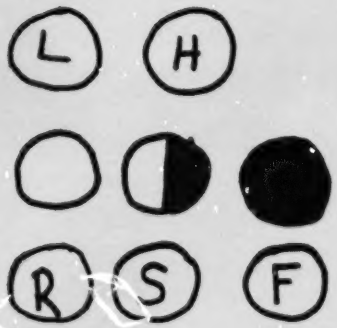
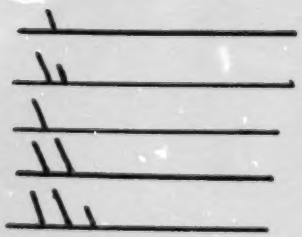
TRY YOUR HAND AT FORECASTING WEATHER!

Bulletin Board Idea





And so on (flannelboard)

Map of the United States

Signs of Fair Weather

You may expect continued fair weather if:

A. The pressure is steady or rising
B. The wind is from the west, northwest, or a little south of west
C. There is a bright red sunset in a clear sky
D. The clouds are very high and do not grow
E. Cumulus clouds are white and decrease toward evening

Signs of Approaching Rain

You may expect rainy weather if:

A. The pressure is falling
B. Cirrus clouds develop and spread into cirrostratus
C. The clouds become lower and thicker
D. Cumulus clouds grow very high and dark
E. The air is very hot and moist
F. A west wind changes to a south or east wind

Signs of Clearing

You can expect the weather to clear if:

A. The clouds rise and scatter
B. The pressure rises and the temperature falls
C. The wind shifts to the west

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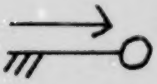
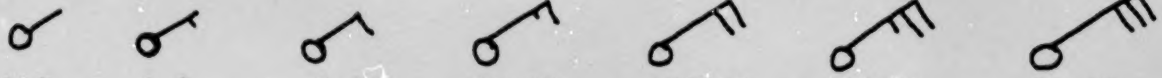
SYMBOLS USED FOR WEATHER MAP

Direction arrow is pointing gives wind direction


wind from west

wind from north

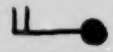
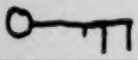
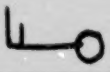
Number of lines on tail of arrow shows speed of wind in miles per hour.



1-2 3-8 9-14 15-20 21-25 26-31 32-37

Circle at head of arrow tells appearance of the sky

clear partly cloudy cloudy rain snow

	Sky	Wind Direction	Wind Speed
			
			
			

Fill in the above chart.

Pretest and Post Test for Fall

1. What causes frost?

2. What is fog?

3. Where is fog generally the thickest?

4. What is the difference between sleet and rain?

5. List 5 changes we can see in the fall.

SLEET

Sleet is frozen rain. It is rain that freezes into clear beads of ice because it passes through a layer of cold air before reaching the ground. The beads bounce when they strike the earth.

FROST

If the temperature is below freezing, the water vapor comes out in the form of ice crystals. This is frost. Frost is formed the same way as dew. (See spring-dew) If the temperature is 32^{o} or lower, the water vapor freezes directly into ice crystals. You can see it on windowpanes, sidewalks, ground and also on plants.

FOG

A swarm of tiny water droplets gather in the air making fog. The droplets form when cold ground cools the air above it so that its water vapor condenses. Fog particles are so small that thousands of them are needed to make a line one inch long. When the temperature is very cold, fogs can form from bits of ice. Dust is one very important element in the make-up of clouds and of fog also. Fog is just a stratus cloud on the ground. The ground fog generally disappears in the morning when the heat of the sun makes it evaporate.

Fog is one of the most dangerous weather conditions for flying at low altitudes and also for driving. When a thick blanket of fog covers the ground it is impossible to see more than a short distance ahead.

In Iowa, another time we see fog is when cold air passes over warm water. The warm water warms up and moistens the lower part of the air. The warmed, moistened air, being made lighter, begins to rise. As it rises it mixes with the cool air, cools again, and loses some of the moisture it had just picked up. This type of fog is often formed at night over a brook in a valley. The river is not cooled much during the night so we have cold air moving over warmer water and a fog is formed.

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FALL ACTIVITIES

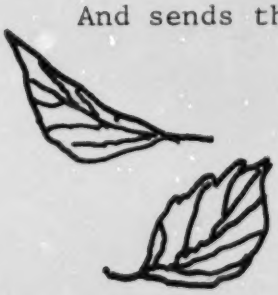
Take a walk on a fall day after the leaves have begun changing colors. As you are walking along have students pick up at least two leaves that look interesting to them. Talk about any other changes that are taking place during this season.

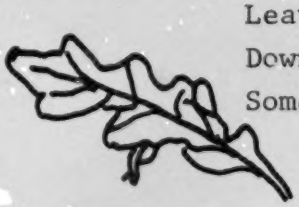
Children may design leaves that were found during their walk. Working in small groups, students make up a short play or skit using their best writing skills. When completed students may present it to the rest of the class.

Bulletin Board-Fall

Leaves are falling softly down.
Some are red and some are brown.

Leaves are floating softly down.
They make a carpet on the ground,
Then swish, the wind comes whistling by
And sends them dancing to the sky.





Leaves are falling,
Down, down, down,
Some are red and some are brown.

On a fog-laden day, take your students outside for a walk. Equip each student with a pencil and a piece of paper stapled to a piece of cardboard. As you and the students walk, each student should make a list of sounds heard, visions created by the fog, how things feel, taste and smell. The walk and making the list will help students focus on their senses.

Pre-test and Post Test for Winter

1. About how many inches of snow equals one inch of rain?

2. What is snow?

3. What is the purpose of a barometer?

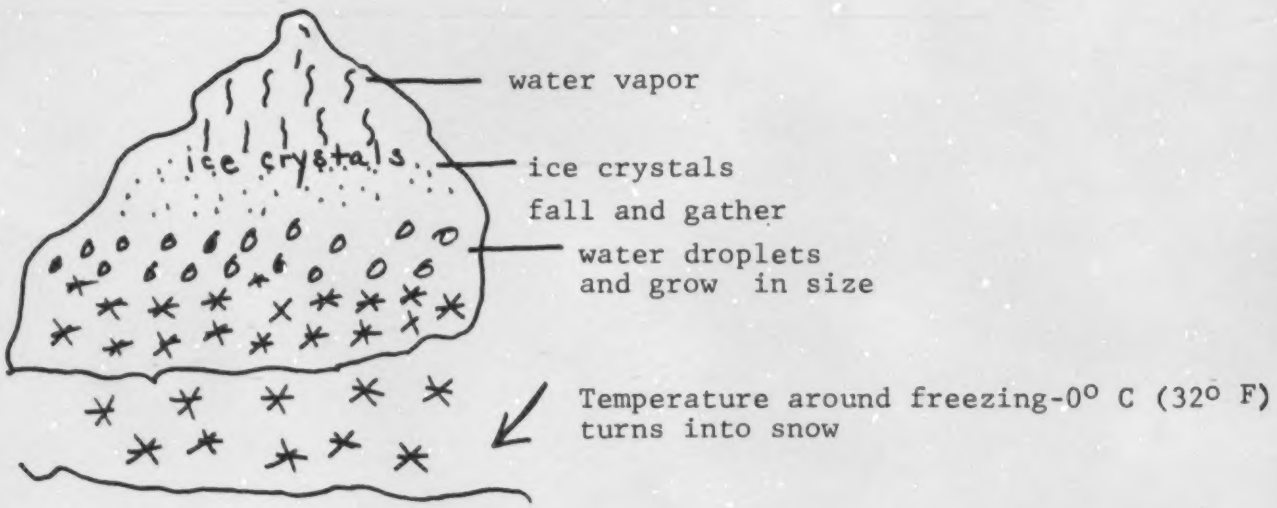
4. What kind of snow do we have in a blizzard?

5. Match terms with definitions:

Heavy snow warning	Strong winds will blow falling snow on the ground into significant drifts
Snow flurries	Intense falls of snow accompanied by gusty surface winds
Snow squalls	Four inches or more in a 12-hour period
Drifting snow	Most dramatic and perilous of all winter storms, characterized by strong winds bearing large amounts of snow
Blizzard	Snow falling for short durations at intermittent periods

Background on Snow

1. Snow is not frozen rain
2. Pictorial example



3. Snow forms around invisible specks of dust that are floating in the air.
4. The ice grows larger until it forms a 6-sided flake we can see.

SNOW

Each tall rain cloud has a top section made of ice crystals and a bottom section made of water droplets. While in the cloud the droplets turn to vapor. Molecules of vapor freeze around ice crystals. If enlarged ice crystals, as they fall to the ground, do not meet any air warm enough to melt them, they reach the ground as snow.

Snowflakes fall slowly and silently, for large amounts of air are trapped among their lacy crystals. It is figured that a blanket of snow is usually nine parts air to one part water.

Sometimes snowflakes are very large. The biggest known fell in Montana in 1887 at a place named Fort Keogh. Some of them fell on a bare field near the Fort and made great white splotches. They were 15 inches across and 8 inches thick. Single snowflkes that would fill a teacup have fallen in other places.

The word snow in a National Weather Service forecast, without a qualifying word such as occasional or intermittent, means that the fall of snow is of a steady nature and will probably continue for several hours without letup.

Heavy snow warnings are defined as snow falling for short durations at intermittent periods. Snowfall during the flurries may reduce visibilities to an eighth of a miles or less. Accumulations from snow flurries are generally small.

Snow squalls are brief, intense falls of snow and are comparable to summer rain showers. They are accompanied by gusty surface winds.

Blowing and drifting snow generally occur together and result from strong winds and falling snow or loose snow lifted from the surface by the wind and blown about to a degree that horizontal visibility is greatly restricted.

Drifting snow is used in forecasts to indicate that strong winds will blow falling snow or loose snow on the ground into significant drifts.

Blizzards are the most dramatic and perilous of all winter storms, characterized by strong winds bearing large amounts of snow. Most of the snow accompanying a blizzard is in the form of fine, powdery particles of snow which are whipped in such great quantities that at times visibility is only a few yards.

Blizzard warnings are issued when winds with speeds of at least 35 miles per hour are accompanied by considerable falling or blowing snow and visibilities are dangerously restricted making it very easy to become lost or stranded.

Severe blizzard warnings are issued when blizzards of extreme porportions are expected and indicate wind with speeds of at least 45 miles per hour plus a great density of falling or blowing snow and a temperature of 10° F or lower.

Traveler's Advisories are issued to indicate that falling, blowing or drifting snow, freezing rain or drizzle, sleet or strong winds all make driving difficult.

Cattle or stockmen's advisories alert farmers that livestock will require protection from wet, windy, chilling conditions.

BLIZZARD

In a blizzard snow is fine and powdery. It is blown by high winds. Very cold air has too little moisture to produce big flakes.

WET AND DRY SNOW

1. Melt some snow and see how much water you get. A normal amount is about an inch of water from ten inches of dry snow. How much more water comes from a "wet" snow?
2. How does the water content of snow change as it becomes old? Melt one sample of new snow and another sample after the snow has been on the ground for a few days.
3. How pure is snow water? There are several ways to find out how much dirt there is in water from melted snow. One way is to filter the water from a paper towel and see how much dirt collects on the towel. Another way is to let the water evaporate from a dish and observe the solid residue that remains.

TREATMENT FOR COLD WEATHER EXPOSURE

Living in Iowa, we should be aware of how to help a person if they have cold weather exposure. If a person shows any signs of overexposure to cold or wet and windy weather, take the following measures-even if the person claims to be in no difficulty. Often the person will not realize the seriousness of the situation.

* Get the person into dry clothing and into a warm bed or sleeping bag with a hot water bottle (filled with warm water), warm towels, heating pad, or some other such heat source.

*Concentrate heat on the trunk of the body first-that is, the shoulders, chest and stomach.

*Keep the head low and the feet up to get warm blood circulating to the head.

*Give the person warm drinks.

*Never give the person alcohol, sedatives, tranquilizers or pain relievers. They only slow down body processes even more.

*Keep the person quiet. Do not jostle, massage or rub.

*If symptoms are extreme, call for professional medical assistance immediately.

SNOWFALKE ACTIVITIES

Collect some snowflakes on a piece of black paper. Examine them with a magnifying glass. Each one looks like a piece of lace. No two are alike. However, all are six pointed.

To see how little water snow contains, fill a kitchen measuring cup with snow and then let it melt. You will get about one tenth of a cup of water.

MAKING A SNOW GAUGE

You can make a snow gauge from a large, wide mouth jar or a tin can. Mark a piece of masking tape with inches and stick it on the jar. Put the gauge outside away from the house and trees.

Use the gauge to measure how much snow falls in each storm during the winter. When a storm ends or the jar gets full, record the depth of the snow on a chart and dump out the snow. Compare your measurements with those given on local weather reports.

EXPERIMENT

Take a narrow jar or wide-mouthed bottle and fill it completely with water. Don't put a cap on it. Put it outside in weather below 32^{o} or in the freezing compartment of your refrigerator. What happens to the water when it has frozen? Now fill a jar full, screw a cap on it tightly, and freeze it outside. Does it break apart?

WIND-CHILL

Calm air	15 m.p.h.	30 m.p.h.	+40 m.p.h.
30	9	-2	-6
20	-5	-18	-22
10	-18	-33	-38
0	-31	-49	-54
-10	-45	-64	-70
-20	-58	-78	-87
-30	-72	-93	-101
-40	-85	-109	-116

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WINTER ART ACTIVITY

Reindeer made from pinecones and twigs. Use two pine cones for body and head. Use twigs for antlers and legs.

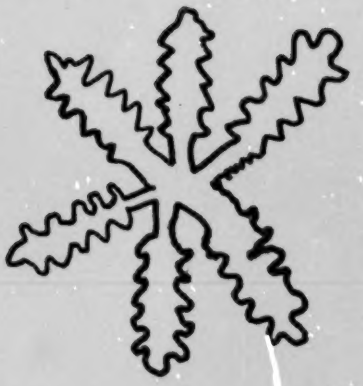
Created by Joan Bransfield Graham

We're made from cones of spruce and pine,
They're glued and pushed together.
We stand on legs of sturdy sticks,
We like this snow weather!
An acron nose, the caps for eyes,
We hold our lacy antlers high.
What a lovely silhouette
Against a frosty winter sky!

ACTIVITY: SNOW FOOLIN'

When snow is just right, the students should discuss what kind of snow is right to make formations, the students can make objects in the snow. When the object has been formed, paint it the colors you want.

What is a Snowflake?



What to do:

Take a piece of black construction paper from the freezer. Catch some snowflakes on it. Observe carefully with a magnifier.

Describe the different flakes_____

_____

_____

Draw a picture of what the snowflakes look like.

Are all the snowflakes alike? _____

Teacher Center

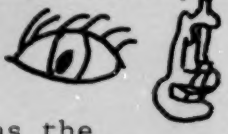
MYSTERY:

How can snowflakes be collected permanently?

What to do:

1. Take slides, cardboard, and clear lacquer spray from the freezer.
2. Place the slides on the cardboard and take everything outside before it becomes warm.
3. Spray a thick layer of lacquer on the slide.
4. Let several snowflakes fall on the sprayed surface.
5. When you have collected several good samples, move to a sheltered area so no more snow can fall on the slides (but still outside).
6. Place a glass jar over your slides and let the lacquer dry for 2 hours.
7. Bring the materials in and let the snowflakes melt.

   *Be careful the slides may still be sticky.

OBSERVE CAREFULLY 

1. What happened as the snowflakes melted? _____
2. Now use the microscope-what do you notice as you compare snowflakes? _____

_____

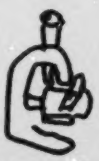
_____

MYSTERY:

How clean is snow?

What to do:

1. Take a clean glass dish outside and let snow fall in it.
2. When the dish is full take it inside.
3. Cover the top so no dust gets in the snow and let it melt.
4. Take a clean piece of toweling and observe it for any specks.
5. Place the paper in a funnel.
6. Pour half of the melted water through the paper into the jar underneath.
7. Examine the paper carefully with the hand magnifier.
8. Place a few drops from both containers of water on slides and compare the two by using a microscope.

OBSERVE CAREFULLY: 

1. Why did you need to observe the paper before pouring the melted water through it? _____

   _____

2. What can you see on the filter paper? _____

   _____

3. What are the differences between the melted water and the water you poured through the funnel? _____

   _____

4. What do you think caused the new material on the paper?

   _____

5. What do you suppose you would see if you magnified a melted snowflake? _____

   _____

Teacher center

WINTER WEATHER FIND

c	j	t	e	r	u	t	a	r	e	p	m	e	t
r	i	a	u	t	e	w	k	c	v	g	d	s	h
s	e	l	f	m	r	e	o	u	a	l	i	c	e
n	f	t	r	t	d	a	v	m	p	g	c	o	r
o	s	o	e	n	t	t	i	u	o	m	e	a	m
w	t	j	g	m	b	h	w	l	r	a	d	s	o
s	n	o	w	x	o	e	o	u	s	i	r	t	m
t	l	r	c	i	r	r	u	s	k	c	a	e	e
o	h	e	y	o	o	q	a	s	y	s	z	k	t
r	p	h	d	e	l	z	f	b	w	t	z	h	e
m	h	o	t	n	g	d	n	i	w	o	i	a	r
e	z	e	e	r	f	a	u	g	r	v	l	l	b
i	m	i	t	t	e	n	s	f	n	e	b	b	e

trails	barometer	snow	sky
weather	clouds	sled	coat
air	cumulus	temperature	cold
cirrus	ice	meteorologist	wind
blanket	stove	vapor	skid
coast	thermometer	snowstorm	mittens
blizzard	sun	blow	fire
fog	jet	storm	freeze

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Pre-Test and Post-Test for Dew, Hail, Rain

1. We can find dew on the ground if the temperature is 32^{o} F. ?

   a. yes b. no

2. What is the main factor that causes dew to form?

   a. evaporation b. condensation c. no water vapor

3. Dew will form if there is wind and clouds?

   a. yes b. no

4. Hailstones are:

   a. frozen snow b. frozen rain c. sleet

5. Hailstones are formed during which type of weather?

   a. before snowstorm b. thunderstorms c. cold, cloudy weather

6. It rains anytime there are clouds in the sky

   a. yes b. no

7. Rain falls from these clouds

   a. cumulus b. cirrus c. stratus

DEW

Remember when we talked about condensation in the section of the water cycle? Well, condensation makes dew if the temperature is above 32° F. During a clear summer night grass, flowers and low bushes cool off quickly at night. This cools the lowest layer of air until it is filled with water vapor. Then the water vapor condenses and collects on the colder ground surfaces.

Dew will not form if there is a wind. A wind mixes the cooler and warmer air which does not leave the right conditions. Another time when dew won't form is when there are clouds. Clouds act like blankets and keep the ground and air from cooling off.

HAIL

Hail is frozen rain. Next time it hails take a hailstone and cut it through the middle. You will notice many layers. Those layers are formed by the up and down motion of hailstones in a cloud before they fall. After raindrops are formed they are carried back up into the cold part of the cloud and turn to ice. As they begin to fall some of the ice may melt. But if these icy beads get up and down in the cloud they continue to add layers of ice until they become heavy and fall to earth. Hailstones are only formed in thunder clouds where there are strong winds which keep tossing them up and down.

Hailstones fall in many sizes. Some are the size of a pea and some can be the size of a grapefruit. As you can see, big hailstones can do a great deal of damage to crops, houses, cars, etc.

ACTIVITIES

A. What was the diameter of the largest hailstone ever measured?

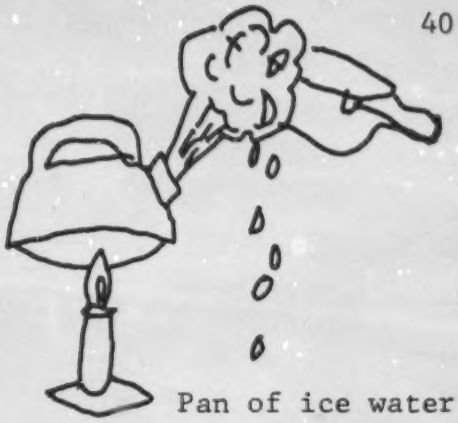
B. Next time it hails, collect some hailstones and cut them open. Compare the number of layers.

C. Measure the diameter of 5 hailstones-compare.

C. Listen for damage reports after hail storms.

RAIN

When does it rain? Anytime there are clouds in the sky? No, the only time it rains is when there are large, heavy drops in the sky. The large drops are formed in clouds that are very high in the sky. These are the cirrus clouds. In these clouds water droplets and ice crystals are side by side. The ice crystals grow larger from the water droplets. When they are heavy enough they begin to fall. As the ice crystals fall they pass through warmer air which melts them and they reach the ground as rain.



Pan of ice water

ACTIVITY:

A. Problem: Where does rain come from?

B. Materials:

1. Teakettle containing 1 or 2 glasses of water.
2. Small sauce pan, filled with a little cold water.
3. Electric plate, or good heating apparatus for boiling water in teakettle.

C. Procedure:

1. Bring water in teakettle to boiling point so steam is rising from spout.
2. Put ice cubes and water in pan.
3. When steam is rising from kettle hold pan of water over spout so steam from spout will strike bottom and sides of pan.

D. Results:

The steam from the kettle, upon striking the cold pan, is cooled and condenses to form droplets of water on the outside of the pan. These droplets collect and fall from the pan like rain falling from a cloud.

E. Supplemental Information:

Water, when heated, rises in the form of vapor into the air. Upon striking cool air; the vapor condenses into tiny droplets of water or moisture. These collect upon particles of dirt in the air to form clouds. When condensed further this moisture falls from the clouds in the form of rain. This demonstration can be used effectively by the pupils in the class to further their understanding of how rain is formed. Used in conjunction with demonstrations can be very effective. The visible part of what we call steam is actually small droplets of liquid water. Water vapor (gas) is invisible.

F. Thought Questions:

1. Why do droplets of water collect on the outside of a glass of ice water?
2. Does the amount of moisture in the air have anything to do with how fast water will collect on the outside of a glass of water?
3. Will insulation on a glass of ice water prevent the droplets of water from collecting on the outside of the glass? Why?

Teacher enter

RAIN GAUGE

Materials:

Black paint
Fine brush
Tall narrow olive bottle
Ruler
Can about 8" wide

Mark the guage this way: Pour water into the can until it is one inch deep. Then pour this water into the olive bottle. Marks its level on the outside with black, and with 1". Empty the bottle, then pour ½ inch of water from the can to the bottle. Mark its level. Repeat, but this time pour ¼ inch of water into the bottle and mark its level.

This is how you use the guage: Set the can in an open place and fix it so it won't tip over. At the end of a storm, measure the rainfall by pouring the water from the can into the olive bottle.

Pre-test and Post-test for Thunderstorms

1. Thunderstorms are caused by

   a. land cooling off b. land heating up too quickly
   c. hot and cold air pressure

2. You can look for thunderstorms if the weather is

   a. hot and stable b. cool and dry c. hot, humid and unstable

3. The falling raindrops become electrically charged because of a strong wind.

   a. yes b. no

4. There is always a sudden guest of _____ wind before the thunderstorm.

   a. cool b. warm c. hot

5. Lightning isn't very dangerous

   a. yes b. no

6. Lightning is attracted to

   a. short objects b. shiny objects c. tall, sharp objects

7. We have thunder before we have lightning

   a. yes b. no

THUNDERSTORMS

Thunderstorms are caused by the land heating up quickly in the summertime. You can look for them when the air is hot, humid, and unstable.

This is how thunderstorms develop: The hot ground warms the air above it. Since the air is heated, it becomes lighter and begins to rise. Since this air that is rising is unstable, once it begins rising, it keeps rising, cooling as it rises. As the air is cooled it forms a cumulus cloud. As the water droplets were formed from vapor a heat was released which helps drive the air up some more. This cloud keeps growing upwards to the level where ice crystals are formed. These crystals grow until they are big enough to fall. As they fall they melt into raindrops. These raindrops have a hard time falling because of the rising air in the cloud. This wind is very strong and breaks up the raindrops. As the raindrops are broken apart they become electrically charged. The very largest drops are the ones that fall to the ground.

As the drops fall they push cool air down which starts a downward movement of cool air. Once this movement starts, it continues faster and faster. So now, in the same cloud there is a strong updraft and downdraft side by side.

The downdraft comes out of the cloud and rolls ahead of the cloud. This is the sudden gust of cold wind that comes before the thunderstorm. Soon the cloud itself comes along with the big raindrops. Sometimes a storm is made up of many such clouds.

As this happens the electric charges are collecting overhead until there is enough power to give a big spark. This spark flashes across the sky and roars as it crashes through air. The flash is lightning and the roar is thunder.

PROTECTION AGAINST LIGHTNING

Lightning can do great damage. It can set a house on fire, it can split a tree, and it can kill people.

Lightning is attracted to tall, sharp objects. If a tree is standing in a field, lightning will most likely strike the tree. Many farmers have lost herds of cows in a thunderstorm because the cows looked for shelter under the tree. So stay away from a tree that stands alone during a thunderstorm.

We protect houses from lightning by using a lightning rod. The sharp end of the rod will attract any lightning and safely carry it to the ground.

Teacher Eater

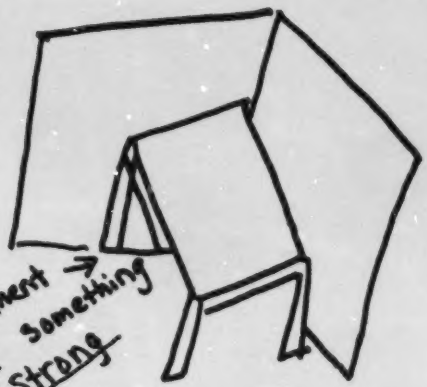
DISTANCE TO A STORM

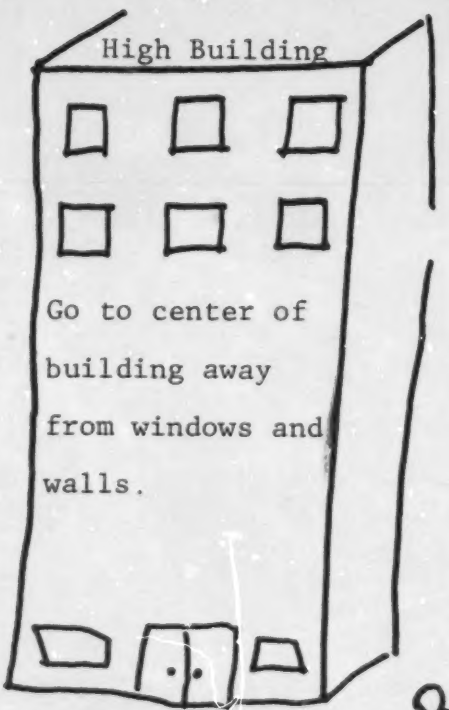
Light travels faster than sound so we always see lightning before we hear the thunder. We can figure out how far away the storm is by counting the time between seeing the lightning and having the thunder. If the storm is two miles away, it takes ten seconds for the thunder to reach our ears. We can figure the distance as one mile for every five seconds. You can count the seconds without a watch saying slowly "a thounsand and one, a thousand and two, etc."

BULLETIN BOARD-TORNADO

Take Shelter!

Strom Cellar





DO NOT STAY IN A

OR

Car

Find a low area and lay flat

Remember
Stay away from windows and outside walls!!

Pre-test and Post-test for Tornadoes

1. What is a tornado? _____

2. A tornadoes' path is very regular

   a. yes b. no

3. The wind speed of a tornado could be

   a. 50-199 m.p.h. b. 200-500 m.p.h. c. 500 or more m.p.h.

4. Two warm air masses are needed for a tornado to form.

   a. yes b. no

5. There is an area in the U.S. referred to as "Tornado Alley"

   a. yes b. no

6. If your in a car and see a tornado approaching, try to outrun it.

   a. yes b. no

7. A tornado watch means:

   a. tornado has been sighted b. conditions are right for a tornado

TORNADOES

A tornado is a spinning wind that may reach the ground. These winds can be anywhere from 200-500 miles per hour. A tornado moves about 20-40 miles per hour and usually leaves a path 1 mile long and 50 yards wide. We can't actually see the wind move, but what we do see is earth, (dust, soil) the water vapor in a cloud, or the objects the wind has picked up. Tornadoes can have many shapes, such as funnel-shaped, or a collection of several small twisters. No tornadoes are exactly alike. We can't tell where they might go or what they may do. That is why they are considered the most dangerous storms of all.

What conditions are needed for a tornado to form? First, there needs to be two different air masses-a cold and a warm air mass. As these two air masses meet, the warm one slides over the cold one. As the warm air rises, both the warm and cold air move in to fill in the space that was left as the warm air was rising. As this happens the warm and cold are fighting for the space and there is a push and shove motion. It is this motion which may start the whirling circular pattern. Once this circular pattern is started, it continues and may be fed by the low pressure area in the center of the circular motion. As the circular pattern is forced into a smaller column it begins to revolve faster. When the winds begin to reach to earth from the

bases of cumulonimbus clouds, the winds revolve faster and the funnel grows deeper.

Tornadoes have occurred in every state and many other countries. But the U.S. has had the most tornadoes than anywhere in the world. There is a four state area in the U.S. that is referred to as "Tornado Alley". The four states in "Tornado Alley" are Texas, Oklahoma, Kansas, and Missouri. This is where the majority of tornadoes occur during the months of April, May, and June. In Iowa our tornadoes happen later in summer. But one must remember that a tornado can strike any time of the day, any month, and anywhere.

Tornadoes can do strange things. For example they have been known to suck water from wells or streams. They can pick up buildings, turn them around and set them backwards on the foundation. It was reported once that it carried a horse away and later dropped it on the ground uninjured. It has picked up a woman, carried her 30 feet and then set her down gently-on her head! A tornado can place sticks into steel pipes and straws into telephone poles. There are many, many more strange things a tornado can do, look for yourself and see how many and what you can find.

How can one survive a tornado? Even if it's a 5 minute warning or a last minute warning knowing what to do can save lives. Because warnings of tornadoes are so important,

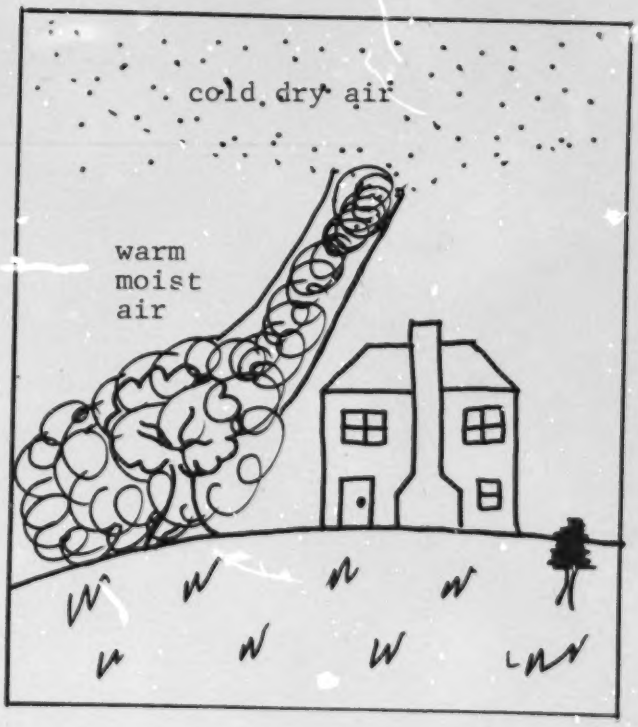
Teacher Created

the United States has a special office, the National Severe Storms Forecast Center, to tell the country when and where there may be serious storms. When listening for weather broadcasts, we need to understand the difference between a watch and a warning. A tornado watch means to be alert for a funnel cloud because the conditions are right for it. A tornado warning means that a tornado has been spotted and it may be coming in your direction. A warning should be taken seriously and you should take shelter right away. Depending upon where you are will determine where you take shelter. If you are in a school there are special areas where you are to go, away from windows and doorways. When you are at home and if you have a basement, shelter should be taken there and get under something strong. If there is no basement go to an inside hallway or closet and stay there. If you are in a mobile home, get out of it and either go to a stronger building or lie flat in a ditch. If you are in a car get out and lie in a ditch. Always make sure that you cover your head with your hands and stay put!

ACTIVITIES

1. Invite a meteorologist to your class to discuss tornadoes and what to do if given a warning.
2. Make a list of strange things done by a tornado.
3. Practice taking shelter depending upon where you might be eg. home, school, store, car, etc.
4. Keep a record from spring to fall, how many tornado watches and warnings were given and the conditions present at the time.

HOW A TORNADO IS FORMED



SUPPLEMENTAL WEATHER ACTIVITIES

WEATHER ACTIVITIES FOR THE CLASS

1. Invite a local weather person to your class to talk about weather. Find out how they study the weather, what kinds of equipment they use, how much and what kind of training they needed to get the job, and what hours they work.

2. Visit a local T.V. station or weather bureau to look at their tools, equipment and procedures first hand. Be sure to ask lots of questions, such as how much weather reporting has been changed by the use of radar, satellites, computers, and other communication devices.

3. Think about and discuss with friends, family, or classmates, how different people are affected by weather. For example, how would the following people react to a rainstorm (snowstorm, hail, high winds, extremely hot weaterr, drought, etc.) farmers, housewives, business people who commute, YOU, school teachers, mail carriers, senior citizens, and any others you may think of.

4. Develop an interview form, using questions of interest to you. Then interview friends, neighbors, relatives, and your own family to get their responses to your questions. Share the results with your classmates.

5. Interview a senior citizen and ask him/her how the weather patterns have changed during his/her lifetime.

6. Watch the weather report daily for one week. Keep track of how accurate the daily predictions are. Graph your information.

7. See how many words you can make from the letters in the word meteorologist. (a person who studies weather)

Teacher Center

WEATHER WORD FIND

H	I	G	H	P	R	E	S	S	U	R	E	A	R	E	A	F
W	A	T	S	R	U	B	D	U	O	L	C	S	T	E	R	M
E	I	I	O	S	T	O	M	E	N	A	E	I	R	R	U	H
N	C	A	L	R	T	P	A	M	R	E	H	T	A	E	W	A
D	L	R	I	S	N	O	N	W	B	G	S	T	R	A	I	N
U	O	C	L	O	U	A	B	U	N	M	I	A	E	I	N	A
O	U	D	I	I	I	T	D	I	R	A	A	G	R	I	B	C
C	D	N	A	J	I	Z	N	O	R	N	U	J	L	R	E	I
N	S	U	N	A	Z	I	T	N	J	A	A	A	T	A	G	R
A	R	H	H	I	T	S	R	A	G	I	H	N	A	A	U	R
M	A	T	L	H	A	E	R	N	M	R	E	R	U	R	A	U
R	T	B	G	I	H	R	I	R	E	R	I	O	E	I	G	H
E	S	I	R	T	E	A	A	D	R	F	E	T	T	E	N	R
H	L	A	O	H	R	T	N	U	F	N	E	F	L	S	I	A
T	I	S	T	H	S	U	R	O	I	M	A	A	T	S	E	B
A	I	A	I	I	H	R	G	W	O	L	H	A	I	O	R	O
E	E	G	E	T	I	N	A	R	N	R	O	T	S	E	S	S
W	H	E	N	A	D	R	A	Z	Z	I	L	B	A	E	R	I
S	T	D	N	I	W	B	R	I	A	F	A	G	W	O	N	S

weather	low	hurricane	hail
rain	barometer	thunder	cloudburst
snow	aircurrent	lightning	fair
tornado	wind	sleet	air
blizzard	Isoban	weathermap	raingauge
high pressure area	storm	weatherman	isotherm
	high	fog	

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Weather Observations for _____ Iowa
(your city)

Date	Wind Direction	Wind Speed	Sky Conditions	Air Temperature High, Low	Rain, fog snow

Keep a weather chart for your town for a certain period of time. Record data daily. When finished answer the following questions:

1. On what day was the wind blowing from the north? south? east? west?
2. Was there a day when there was no wind?
3. How many days did it rain? snow?
4. What was the coldest day of the week? the warmest?
5. What was the high temperature for the week? the lowest temperature?
6. What was the average high temperature for the week? the average low temperature?

Teacher Center

ACTIVITY

Concept: Weather affects all living things

Objective: Student will be able to relate weather to what is happening in the world around him on a daily basis

Materials:

2 cans the same size
white paper
black paper
thermometer

Wrap white paper around one can and black paper around the other. Put a thermometer in each can. Set cans so that sun shines on them. Wait 20 minutes. Look at thermometers.

Discuss and relate experiment to why Iowans wear light colored clothing in summer, and dark in colder months.

WEATHER Area 7:

1527	Climates of the United States	(4th gr.)
1512	Clouds	P
1897	Snowflakes	P
1105	Thermometers: how they help us	PI
1463	Weather-air in action (fronts and storms)	IJ
1458	Weather-air inaction (pressure and humidity)	IJ
1470	Weather-air in action (temperature and wind)	IJ
1894	Weather for beginners	P
1157	Causes of the seasons	I 1962
2485	Climate and the world we live in	IJ 1957
2203	Climates of North America	IJ 1962
1527	Climates of the United States	IJ 1962
1512	Clouds	P 1966
1788	Earth-it's water cycle	IJ 1974
1537	Families and weather-what's weather like	P 1967
2182	Origins of weather	IJ 1963
2562	Snow	IJS 1962
3495	Storms-the restless atmosphere	IJS 1974
1041	Thermometers and how they work	PI 1962
2588	Tornado	IJs 1968
1407	Weatherman-a scientist	I 1970
2373	What makes clouds	IJS 1965
2374	What makes the wind blow	IJs 1965
2232	Wind and what it does	PI 1963

Area 7 books:

E	Smith	Fog is secret	P
F	Williams	Danny Dunn and the weather machine	I
F	Frye	Days of sunshine, Days of rain	PI
F	DeJung	Horse came running	IJ
525	Fisher	I like weather	P

551.5	Depaola	Cloud Book	P
551.5	Branley	Flash, crash, rumble and roll	PI
551.5	Branley	Rain and hail	PI
551.5	May	Weather	P
551.5	Bendick	Wind	PI
551.5	Brewer	Wind is air	P
551.5	Stone	Winds of weather	I
551.59	Friskey	True book of air around us	PI
551.6	Waller	Book to begin on weather	PI
551.6	Schneider	Everyday weather and how it works	I
551.6	Rubish	Forecasting the weather	IJ
551.6	Knight	Let's find out about weather	IJ
551.6	Ross	Weather	IS
551.6	Waller	Weather	P
551.6	Stambler	Everyday weather and how it works	I
551.6	Syrocki	What is weather	IJ
551.68	Bova	Man changes the weather	IJ
619.43	Carlisle	Satellities, servants of man	IJS

Teacher center

*GAME: AVERAGE PRECIPITATION (1-2 players)

1. Numbers are put on the rain drops.
2. 3 markers are tossed
3. Average the numbers upon which the markers fell. Those are your points for that turn. After each person has 4 turns add up your points. The person with the most points wins.

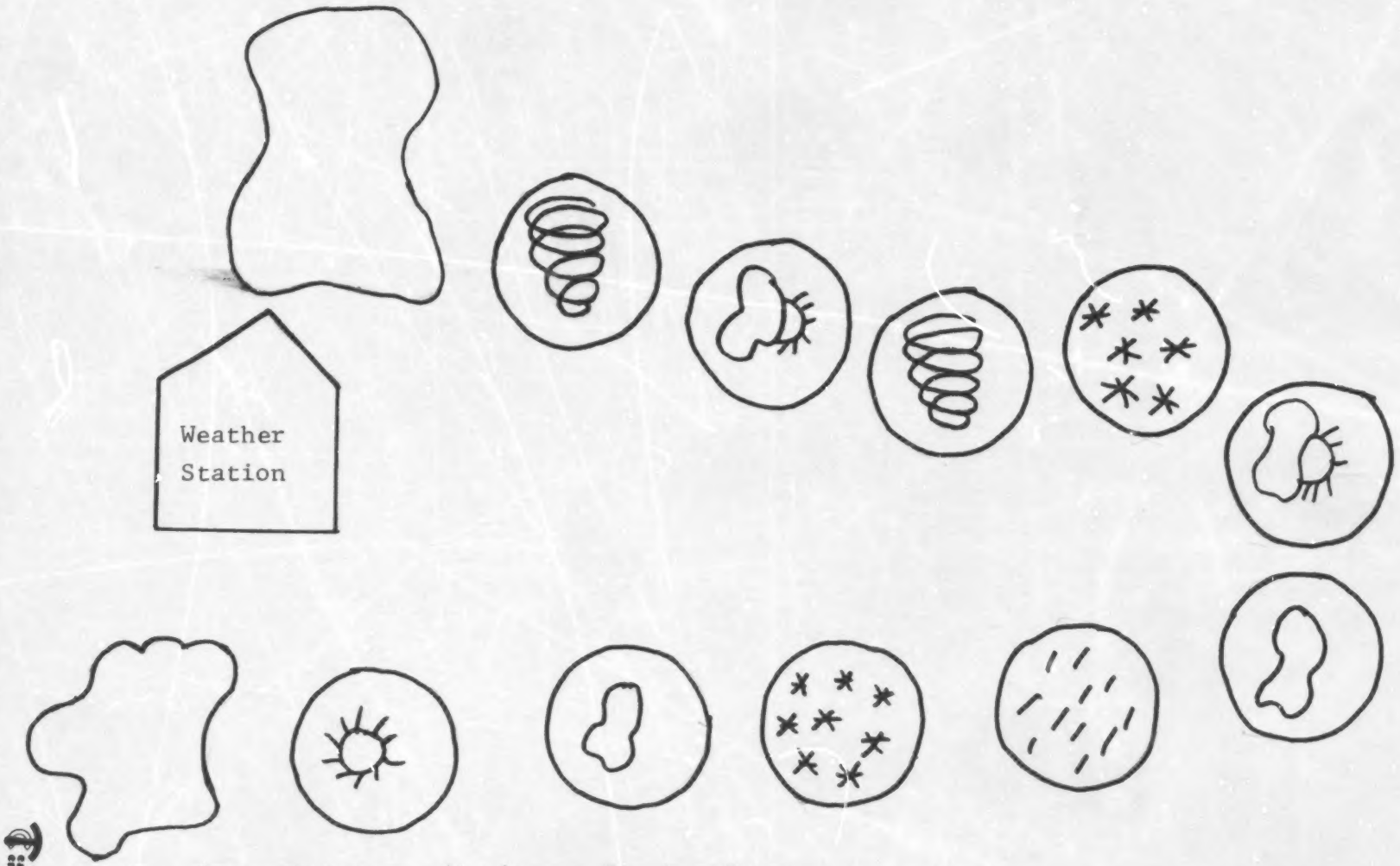
*Actual game on display at Teacher Center

*MARCH MYSTERY-Folder Game

Make 5 cards of each weather condition-sunny, cloudly, rainy, snowy, partly cloudy, tornado

Directions:

1. Start on bottom cloud
2. Draw card-move to matching symbol
3. Give good descriptive sentence or tell type of activity that could be done that day.



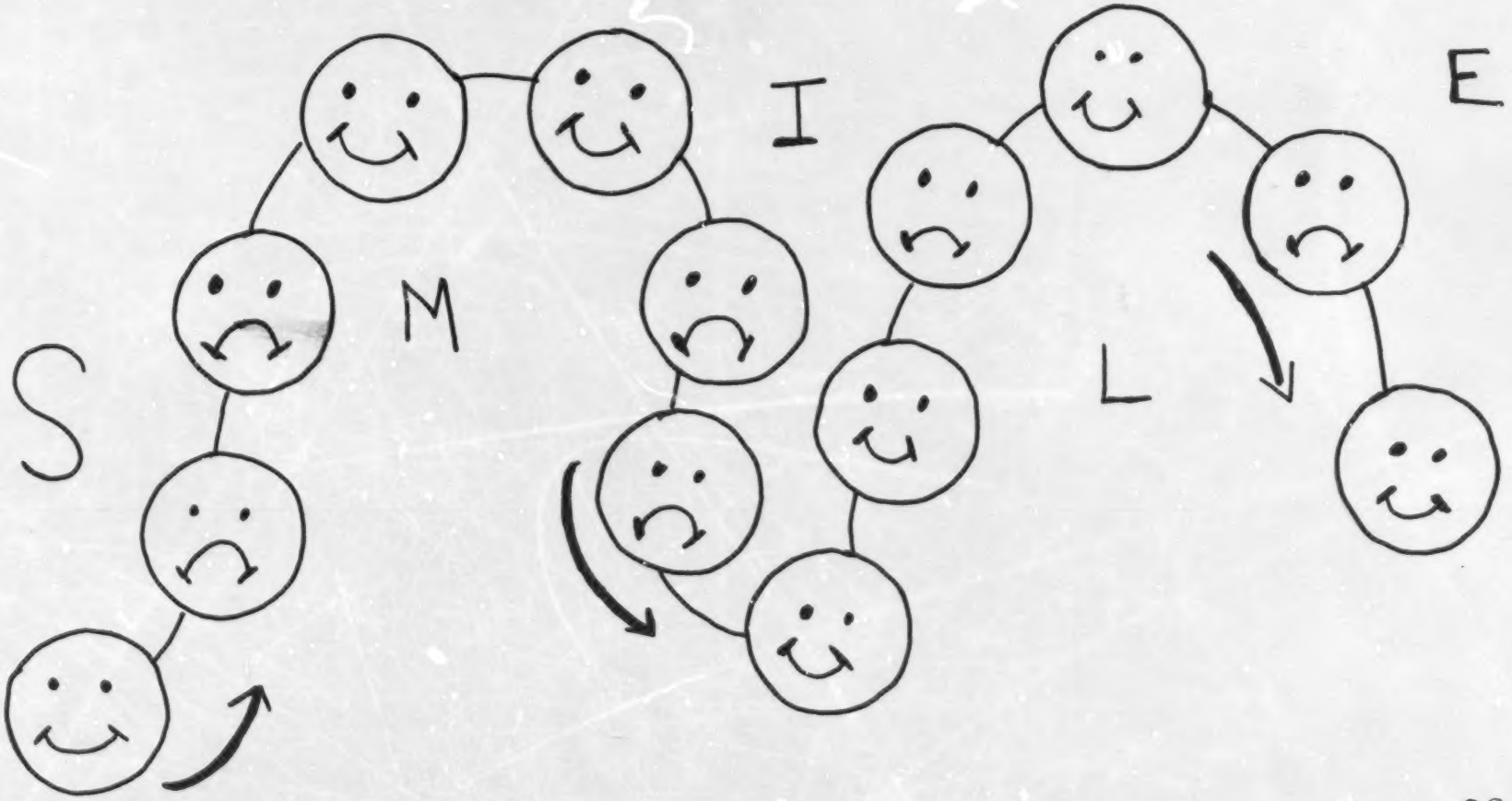
*Actual game on display at Teacher Center

*SMILE- Folder Game

This game can be used with any season.

Write statements on small cards dealing with the weather. These statements should be able to arouse a feeling either happy or sad. The cards are placed face down on the board. Students take turns picking a card, reading it and giving a reason why it makes him/her happy or sad. The player moves to the appropriate happy or sad face.

Directions: A student as a player turns a card over and reads it out loud. If the player determines the sentence is sad, he moves to the next sad face on the game trail. If the player determines the sentence to be happy, he moves to the next happy face on the trail. The first player to cross the finish line is declared the winner.



*Actual game on display at Teacher Center

SMILE-Folder game

Sentence Examples:

1. The sky is bright today.
2. My Dad's car was dented by the hail.
3. We were halfway across the muddy stretch when the rains came again.
4. The air was so heavy and sun so bright as we walked through the field.
5. With our rain today, the garden is sure to grow.
6. The snow is just right for building a snowman today.
7. The lightning struck the horse as it was standing under the tree.
8. I couldn't sleep last night because my back was blistered from the sun.
9. The ducks will have to leave when the pond freezes over.
10. That tornado almost flattened our house.
11. The heavy rains flooded Grandma's house.
12. We were tucked in bed as the storm struck.
13. There were dark clouds in the sky as we drove to the park.
14. My plane has been fogged in.
15. The snow was so deep we couldn't get to school.
16. The heavy rains melted our snowman.
17. What will mother think when she sees I went through a mud puddle.
18. Mothers clothes dried quickly on the line.

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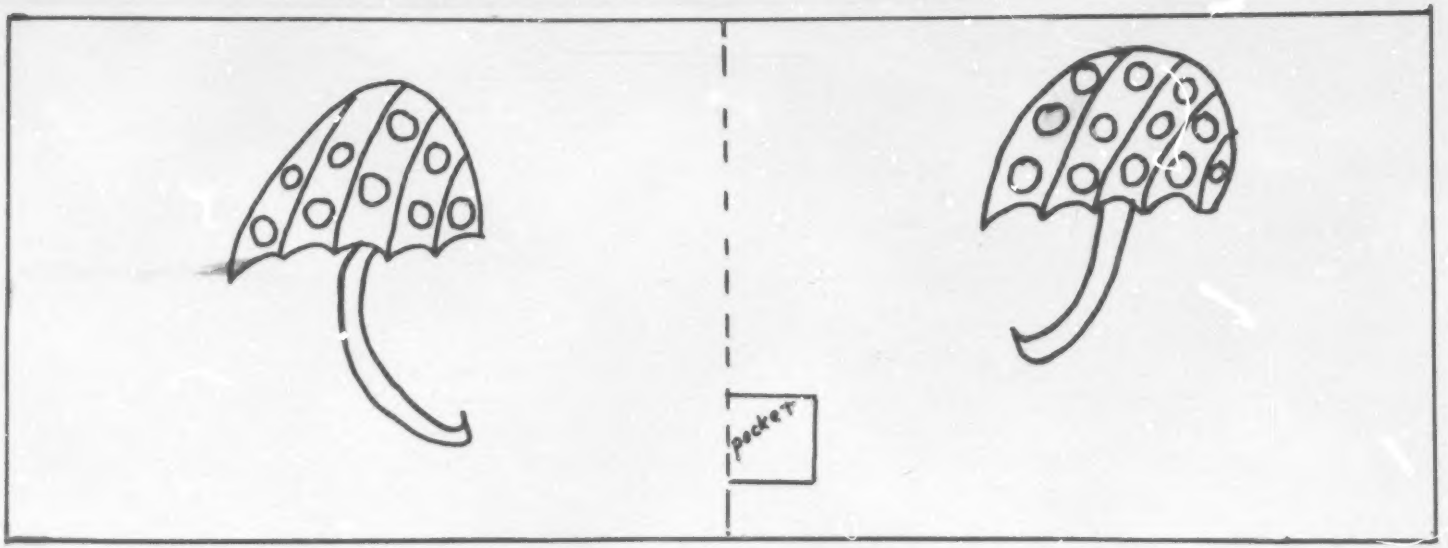
*THE POLKA DOTTED UMBRELLA-Spring Folder Game

Write adjectives on the circles in the umbrellas. On smaller circles, also write nouns. Store the noun circles in the pocket. Students match the noun dot to the appropraite adjective dot on the umbrella.



Examples of nouns:

butterflies	puddle
wind	umbrella
sun	clouds
rain	ladybug
sky	thunder
snake	lightning

Examples of adjectives

polka-dotted	blue	cold
dark	deep	bright
rising	sandy	hot
muddy	fuzzy	lazy
yellow	stifling	singing
red-spotted	wavering	black

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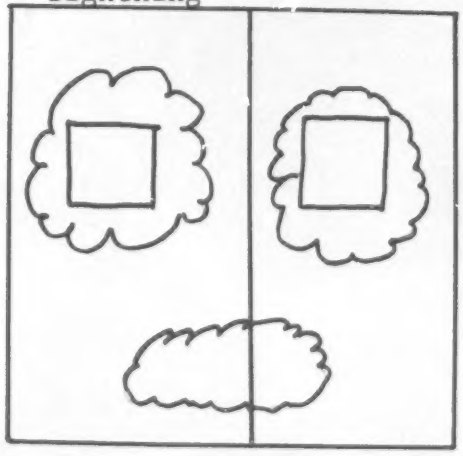
*Actual game on display at Teacher Center

*THUNDER IS: Spring Folder Game

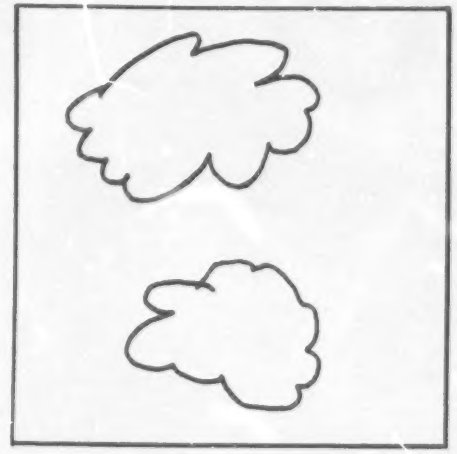
Students take a shape out of one of the pockets and write a sentence about the thunder or lightning on the shape. A single sentence well stated, can be an adequate response. Allow the students to post the finished sentences on the bulletin board.

Front cover

Inside Cover· Pockets contain pictures of thunder clouds and lightning



Back cover: In one of clouds put the directions.



*Actual game on display at Teacher Center